

DMO

At the end of this Session, you will be able to:

- **Define the term 'DMO' and describe why we need to apply DMO to seismic data.**
- **Define the equation for DMO.**
- **Describe the effect that DMO has on stacking velocities.**
- **Describe on which data the DMO correction will be largest.**

DMO

Anytime we have dipping events within our seismic section (i.e. ALWAYS!) our seismic data will not be recorded at the correct spatial position and the assumption that a Common Mid Point is the same as a Common Depth Point breaks down.

The problem varies with offset and can be handled in two stages. *DMO* or *Dip-Moveout* correction before stack (to correct the CDP/CMP mis-match), and *Migration* (generally after stack) to correctly position the data in space and time.

DMO

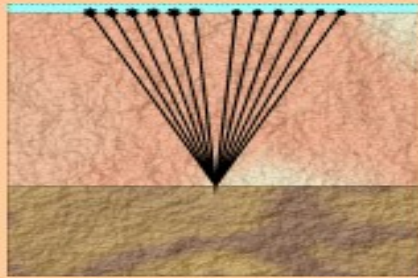


Figure 1

Figure 1 shows reflections from a flat horizon. In this case the common depth point is positioned on the common midpoint.

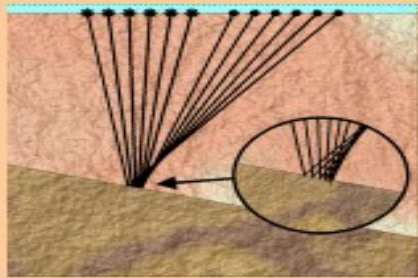


Figure 2

Figure 2 shows that for a dipping horizon the common midpoint gather will have a spread of reflection points.

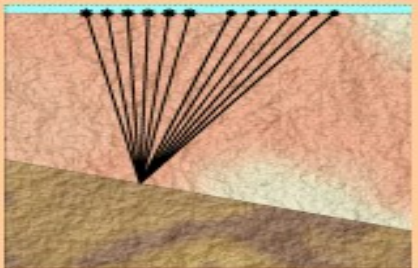
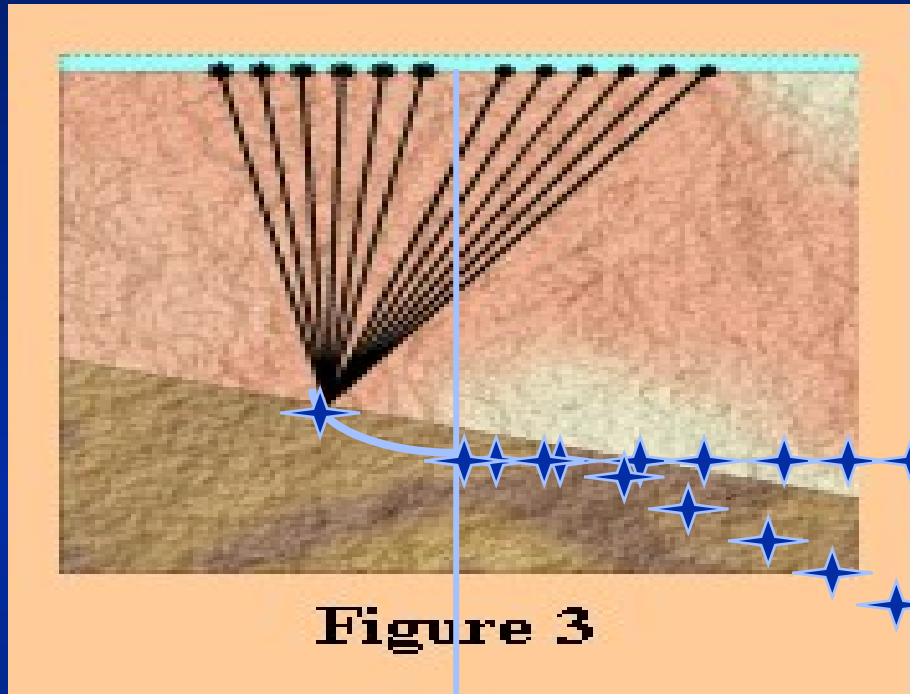


Figure 3

Figure 3 shows the post DMO result. The reflections have been moved to their true common depth point.

DMO



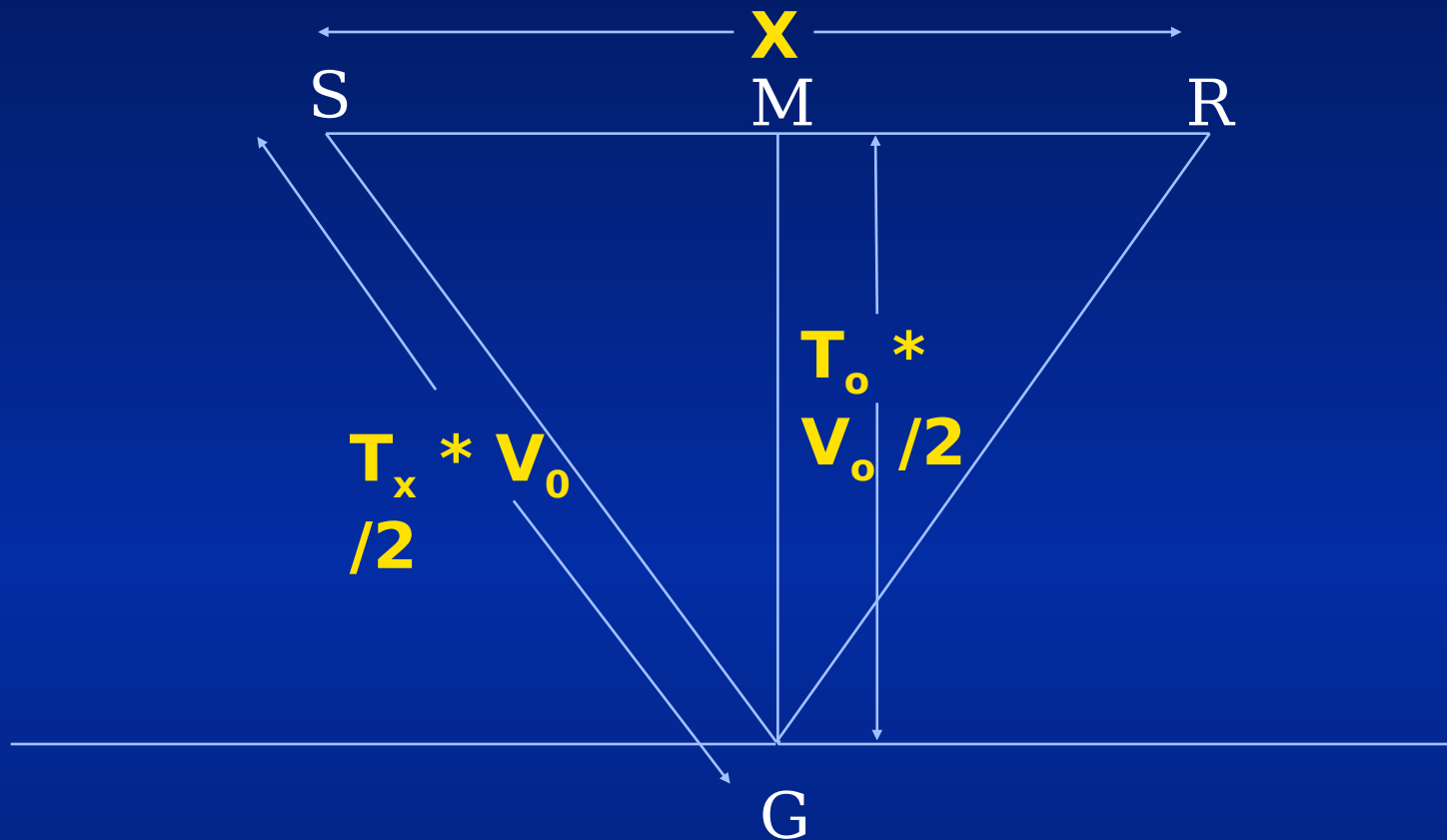
After DMO the common depth points still form a hyperbolic curve on the CMP gather.

The velocities are repicked to flatten the hyperbole.

The common depth points are stacked together.

The stacked event is then migrated to its correct position.

Moveout for a Flat Horizon

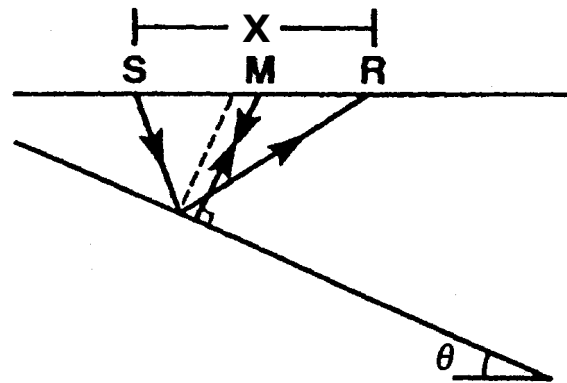


PYTHAGORAS: $(T_x * V_o)^2 = (T_o * V_o)^2 + X^2$

or $T_x^2 = T_o^2 + X^2 / V_o^2$

Moveout for a Dipping Horizon

Moveout for a Dipping Layer



$$t^2 = t_0^2 + \frac{X^2 \cos^2 \theta}{v^2}$$

- Important for
1. Large Dips
 2. Shallow Reflectors
 3. Large Offsets
 4. Low Velocities

DMO.2

Dip-Moveout Correction (DMO)

The CMP stack is an approximation to the zero-offset case - based on NMO correction -

$$T_x^2 = T_o^2 + X^2 / V^2$$

But for dipping layers, correction should be -

$$T_x^2 = T_o^2 + X^2 \cos^2 \theta$$

Or

$$T_x^2 = T_o^2 + \underbrace{X^2 / V^2}_{\text{NMO term}} - \underbrace{X \sin^2 \theta / V^2}_{\text{DMO term}}$$

DMO Velocities

$$T_x^2 = T_o^2 + X^2 / V^2 - X \sin^2 \theta / V^2$$

So we can see from this equation the DMO correction is a negative correction, so with increasing dip we have a decrease in moveout.

After application of DMO we would expect to pick slower velocities

Also from the above equation we can see that the DMO correction increases as offset and dip increase and decreases as velocity increases

DMO Velocities

$$T_x^2 = T_o^2 + X^2 / V^2 - X \sin^2 \theta / V^2$$

None of the "routine" methods of DMO require any knowledge of dip.

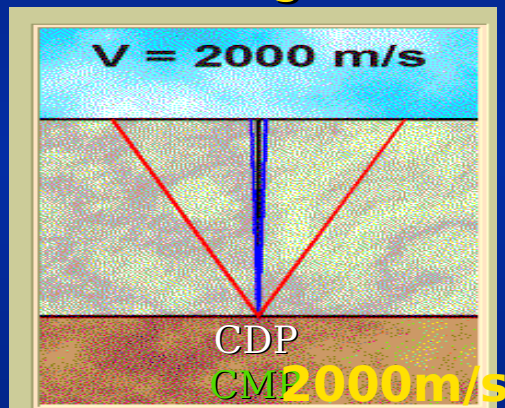
The various algorithms move the data for each offset "plane" into all possible zero-offset positions.

Believe it or not, the signal within the data combines correctly whilst the noise (and the data that is in the wrong place) cancels out.

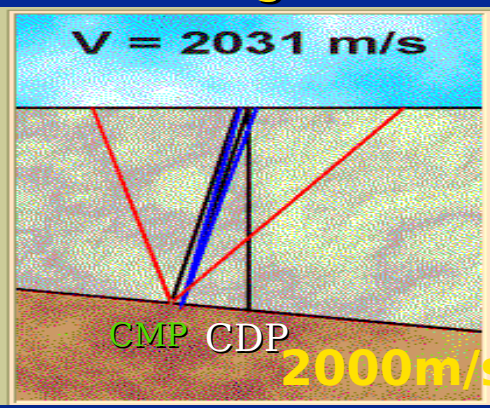
A closer look

res below we have a layer with a velocity of 2000m/s, if the layer has
n it appears on our velocity analysis to have a higher stacking velocity
t for the dip (apply dmo) then our velocity analysis will indicate that
ty of 2000m/s.

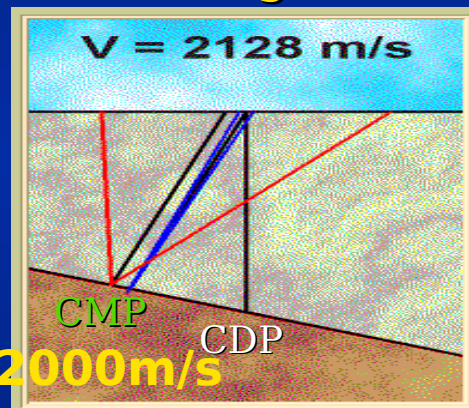
0 Degree



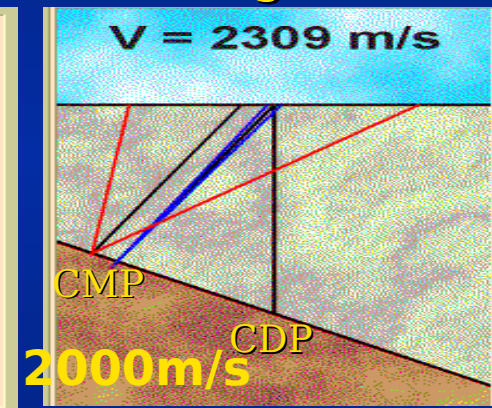
10 Degree



20 Degree



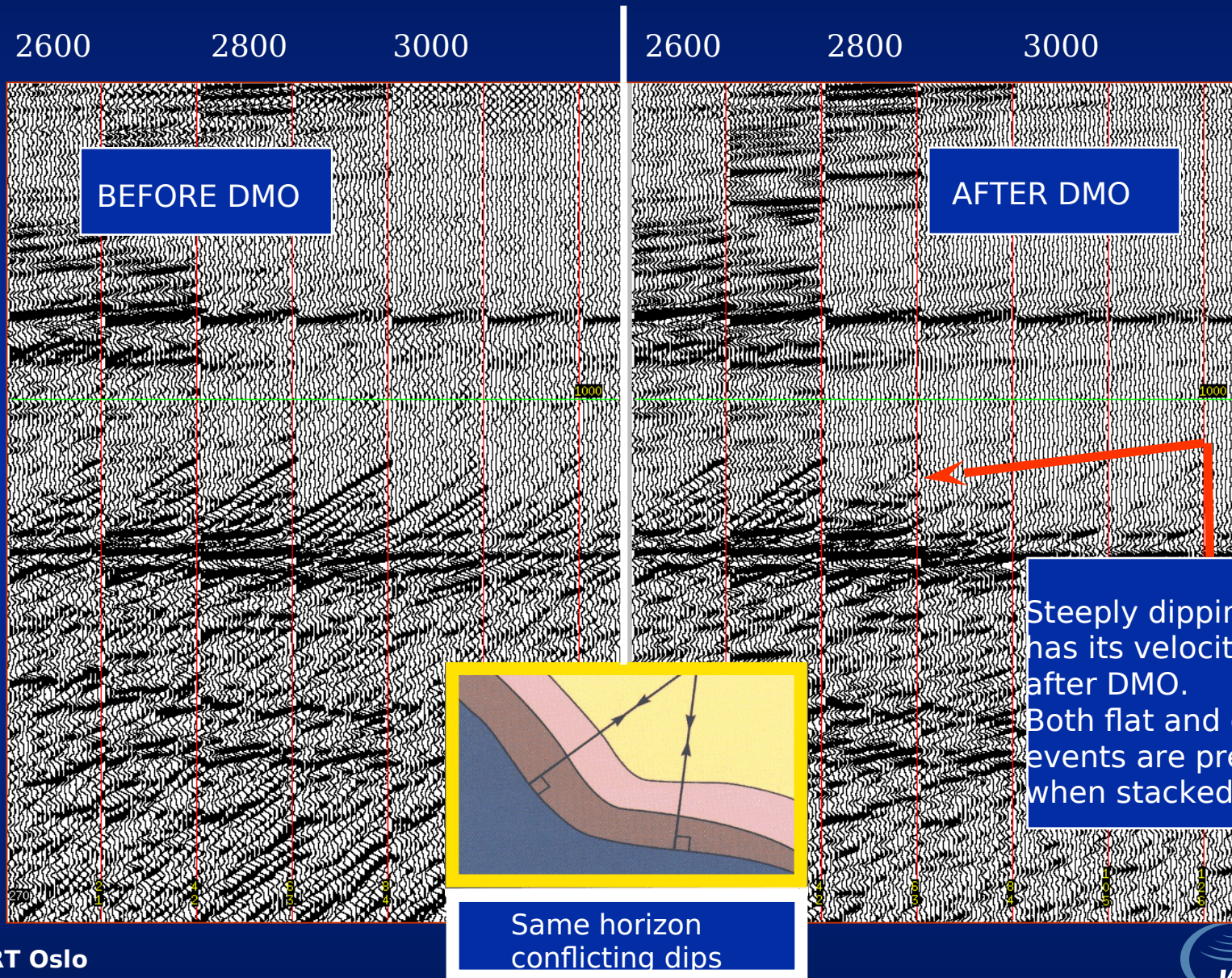
30 Degree



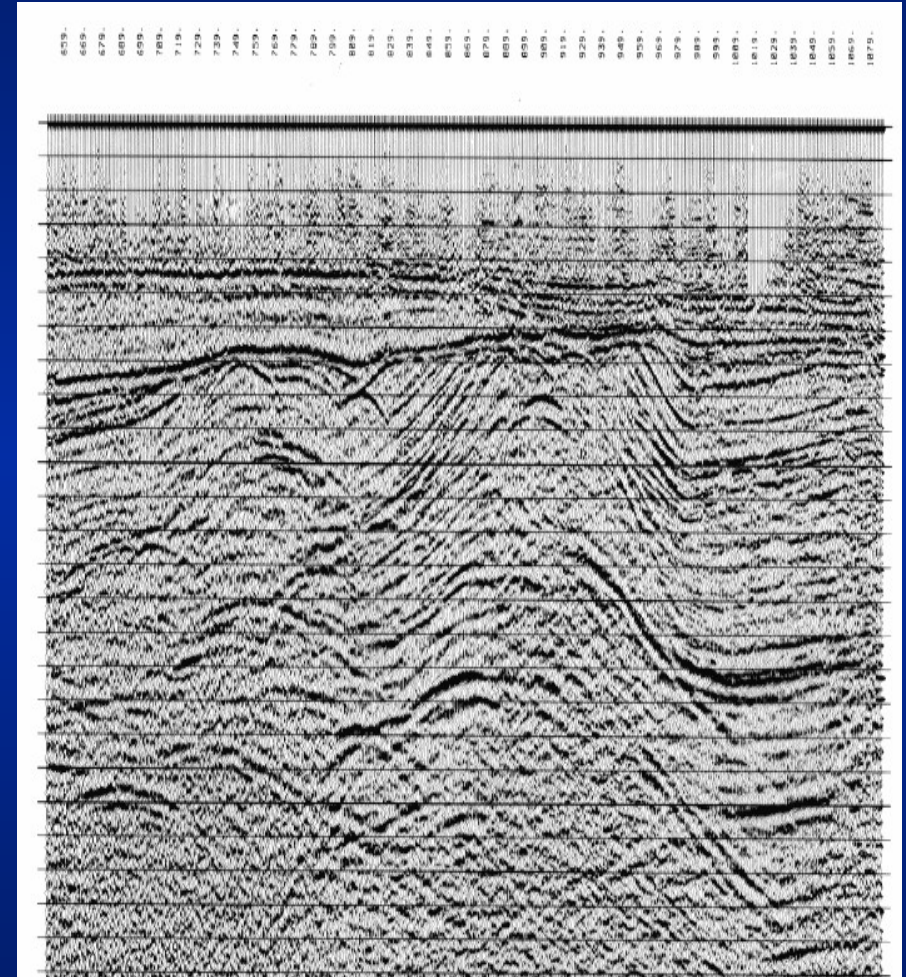
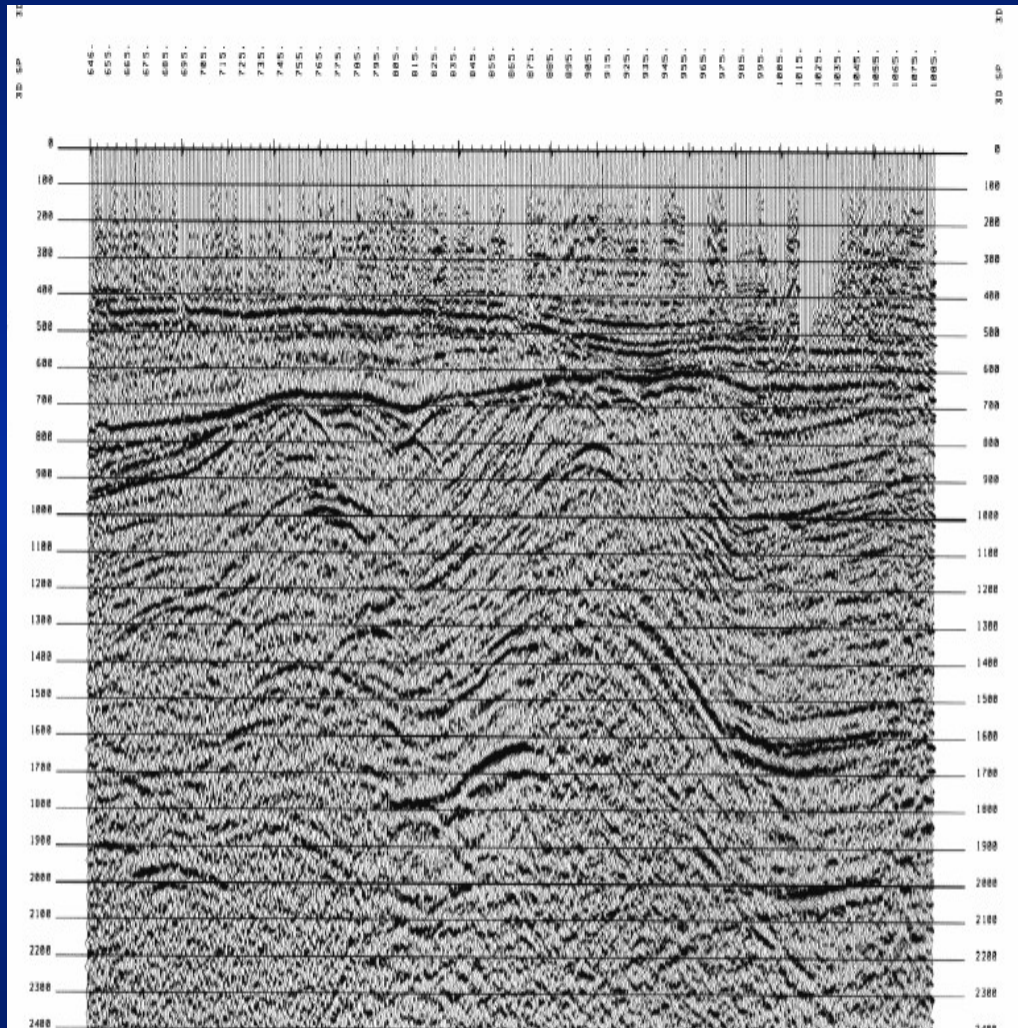
Dip (Deg)	Cos.	1/Cos.	Velocity
0	1.0000	1.0000	2000
10	0.9848	1.0154	2031
20	0.9397	1.0642	2128
30	0.8660	1.1547	2309

Stacking velocities are modified by the structural dip, which is also dependent on the source-to-receiver azimuth

DMO - Velocities



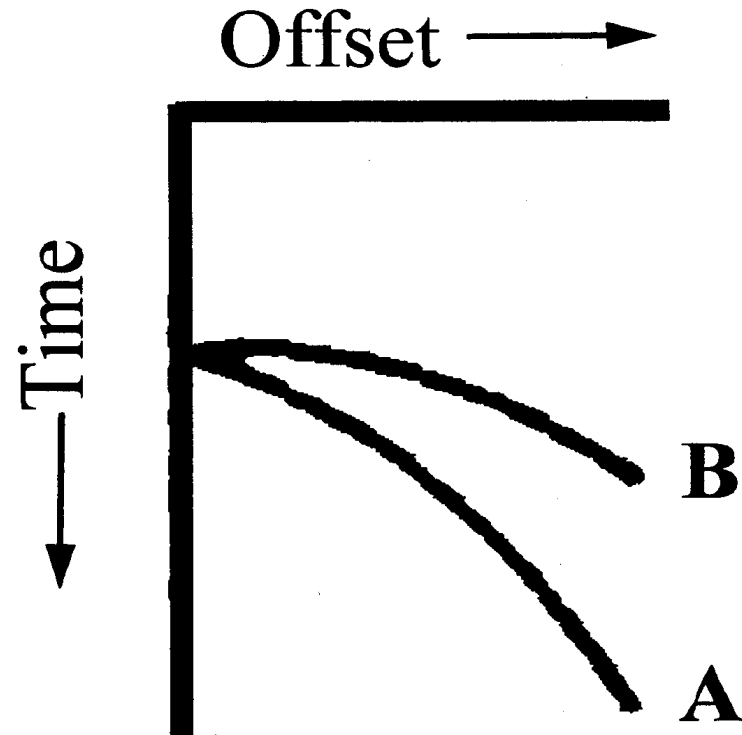
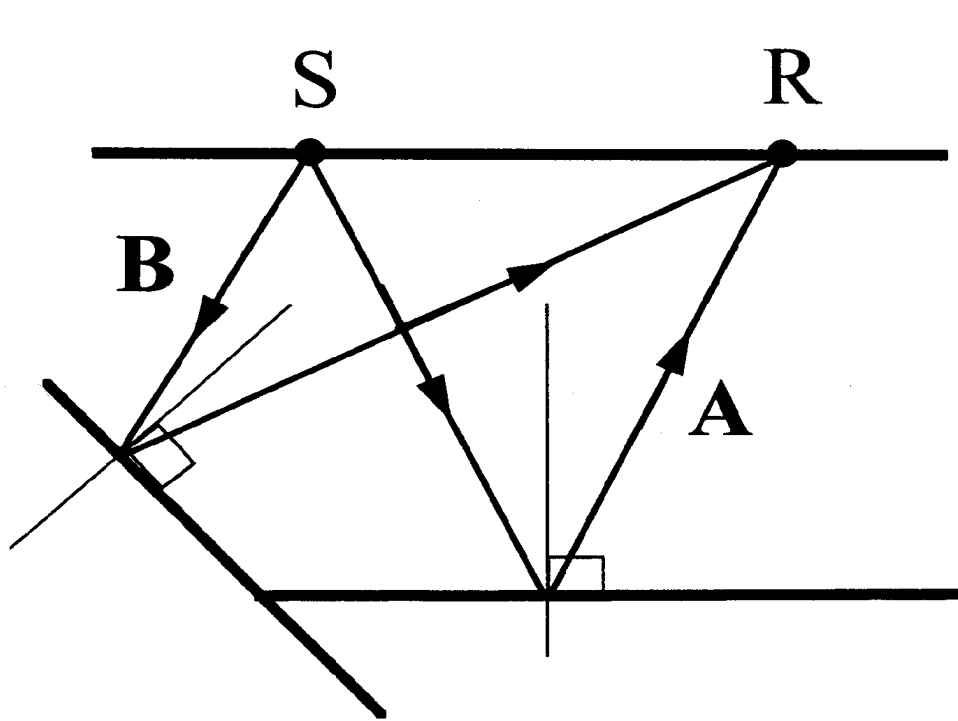
Data Examples



DP **Conventional Stack**
2004

DMO Stack 

Conflicting Dips



in constant velocity medium, we will have different moveout when conflicting dips are present. The energy from both appear in the same CMP. DMO will solve it!

DMO - A Pre-Stack Partial Migration

$$\text{DMO} + \text{Post Stack Migration} = \text{Full Pre Stack Migration}$$

↑
*corrects for reflector
dispersal*

↑
*repositions reflection points
to true subsurface location*

↑
does both

DMO allows post-stack time migration to become equivalent to pre-stack time migration only in a **constant velocity** environment .

Whats the processing sequence for dmo

- **Velocity analysis - coarse spacing**
- **Approximate NMO**
- **DMO (common offset domain)**
- **Inverse approximate NMO**
- **Velocity analysis - fine spacing**
- **NMO**
- **Stack**
- **Time migration**

Recap - DMO

migrates each trace to zero-offset

removes reflection point smear for non-zero offsets

removes dip-dependence from stacking velocities

improves velocity analysis - more appropriate for migration

preserves diffractions - improves definition of discontinuities

attenuates coherent noise with impossibly steep dip

can be used (optionally) to interpolate missing traces